

**Response Under 37 CFR 1.116**  
**Expedited Procedure**  
**Examining Group 2800**  
Application. No. 10/730,162  
Response dated April 9, 2007  
Reply to Final Office Action of February 8, 2007  
Attorney Docket No. 4444-032065

### **REMARKS**

The Office Action of February 8, 2007 has been reviewed and the Examiner's comments carefully considered. Claims 1-20 are pending in this application, and claims 1, 14, 15 and 17 are in independent form. The Examiner has withdrawn the rejections set forth in the previous Office Action of November 2, 2006 in light of the arguments made in the previous Response of January 18, 2007.

In the present Office Action, the Examiner has again rejected all of the pending claims 1-20. Specifically, claims 1, 2, 4, 6-8 and 14 stand rejected under 35 U.S.C. § 103(a) as being obvious over the previously-cited Ward patent in view of the previously-cited '099 publication. Further, claims 9-12 and 15-17 stand rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent and the '099 publication, in view of the previously-cited Kanada publication. Further, claim 3 stands rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent in view of the '099 publication, and in further view of the previously-cited Yamaji patent. Claims 18-20 stand rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent, the '099 publication and the Kanada publication, and in further view of the Yamaji patent. Claim 13 stands rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent and the '099 publication, and in further view of the previously-cited Thomas patent. Finally, claim 5 stands rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent and the '099 publication, and in further view of the previously-cited Inoue patent and Ogura patent.

Therefore, the Examiner uses seven different prior art references in various combinations in formulating the rejections of the presently-pending claims. While the Examiner has removed the '099 publication as the primary and anticipatory reference, the various other prior art references cited throughout the prosecution of this application (including the '099 publication) are again used in rejecting the pending claims. In particular, it appears that the Examiner believes that the combination of the Ward patent, which uses a woven fabric as a base layer, and the '099 publication, which uses polyethylene naphthalate material, teach or suggest the claimed invention. Applicants respectfully disagree and, in view of the following remarks, request reconsideration of these rejections.

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Summary of the Invention

In one embodiment, and as set forth in independent claim 1 of the present application, the present invention is directed to a loudspeaker diaphragm. This loudspeaker diaphragm includes a base layer having a woven fabric. This woven fabric is polyethylene naphthalate fiber impregnated by the thermosetting resin.

As set forth in independent claim 14 of the present application, and in another embodiment, the present invention is a loudspeaker that includes a loudspeaker diaphragm. The diaphragm includes a base layer. The base layer is formed from a woven fabric of polyethylene naphthalate fiber impregnated with a thermosetting resin.

Independent claim 15 of the present application is directed to a method for manufacturing a loudspeaker diaphragm. This method includes the steps of: impregnating a woven fabric of polyethylene naphthalate fiber with a thermosetting resin and curing the thermosetting resin, so as to form a base layer; adding an inactive gas at a super critical state to a molten thermoplastic resin and extruding the mixture of the thermoplastic resin in the inactive gas at prescribed temperature and pressure, so as to form a thermoplastic resin layer; and laminating the base layer and the thermoplastic resin layer. Accordingly, the claimed method leads to the manufacture of the unique loudspeaker diaphragm of the present invention.

Independent claim 17 of the present application is directed to a loudspeaker diaphragm. This loudspeaker diaphragm includes a base layer as the outermost layer, as well as a thermoplastic resin layer and a thermoplastic elastomer layer. The base layer includes a woven fabric of polyethylene naphthalate fiber impregnated with a thermosetting resin.

According to the present invention, a loudspeaker diaphragm is provided and set forth in the independent claims discussed above. The loudspeaker diaphragm includes a base layer that has a woven fabric of a polyethylene naphthalate (PEN) fiber, and this woven fabric is impregnated with a thermosetting resin. As previously discussed in the last Response (which is incorporated herein by reference), a loudspeaker diaphragm manufactured in accordance with the present invention has an excellent balance between a Young's modulus and an internal loss. In particular, if a woven fabric is used for a base layer, respective fibers constituting the base layer would easily slip when the diaphragm is

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vibrated. As a result, vibration energy is converted into heat energy, such that an internal loss would become large. However, since a woven fabric of PEN (as used in the present invention) has an extremely large weave density, there exists a small amount of a thermosetting resin as a binder resin between fibers constituting the woven fabric and a resultant diaphragm. As a result, a laminated structure having a woven fabric layer and a resin layer is substantially formed in the base layer, and such a structure contributes to further improvement of an internal loss. Still further, due to the extremely large weave density of the PEN woven fabric, the Young's modulus can be satisfactorily maintained. Therefore, a loudspeaker diaphragm simultaneously satisfying excellent Young's modulus in internal loss, which could not be obtained by the prior art, is thus realized.

The Cited Prior Art

The Examiner has referred to the '099 publication, the Ward patent, the Kanada publication, the Watanabe publication, the Yamaji patent, EP '596, the Inoue patent and the Ogura patent throughout the prosecution of this application. The Examiner has now withdrawn the '099 publication as a primary reference, instead using it as a secondary reference in combination with the Ward patent.

As previously discussed, the diaphragm of the '099 publication is a "film" diaphragm for use in connection with a micro speaker. In particular, the film diaphragm of the '099 publication provides various benefits with respect to commonly-used polyester films. However, it should be noted that the method of production and resultant film diaphragm taught by the '099 publication is only applicable for use and able to be used in connection with a loudspeaker having a very small diameter (micro speaker). Therefore, in summary, the '099 publication teaches or suggests the use of a polyethylene naphthalate film for use in connection with small-diameter diaphragms and micro speakers. Accordingly, the '099 publication teaches the use of polyethylene naphthalate, but only in connection with a different field of endeavor, and only in connection with the creation of a film for specific use in this "micro speaker" application.

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The Cited Prior Art Does Not Teach or Suggest a Loudspeaker  
Diaphragm Having a Base Layer of Woven Fabric of PEN Fiber

Applicants note that the Examiner combines the teachings of the '099 publication and the Ward patent in an attempt to obviate the presently-claimed invention. As discussed below, the present invention provides new and unexpected results not seen in the prior art, including the '099 publication, the Ward patent and the remaining art of record. In addition, none of the cited prior art, including the '099 publication and the Ward patent, teaches or suggests the use of a woven fabric of polyethylene naphthalate fiber. Instead, and as discussed hereinafter, the Ward patent teaches the use of a woven fabric of aramid fiber, and the '099 publication teaches the use of a polyethylene naphthalate film material. Therefore, even if combined, this combination does not teach or suggest the use of a PEN woven fabric, as set forth in each of the independent claims.

In the present application, various examples of the invention have been provided. Table A (below) summarizes the results of Examples 1 and 3.

Table A

	PEN (Example 1)	PEN impregnated with melamine resin (Example 3)
Density (g/cm <sup>3</sup> )	1.01	1.01
Young's modulus (dyne/cm <sup>2</sup> )	3.44 x 10 <sup>10</sup>	5.20 x 10 <sup>10</sup>
Internal loss (tan $\delta$ )	0.45	0.45

In particular, Table A shows that the impregnation of PEN with melamine improves Young's modulus while excellent internal loss is maintained.

The primary reference, namely the Ward patent, indeed teaches a loudspeaker diaphragm that includes a base layer of woven fabric. However, the woven fabric taught by the Ward patent is aramid fiber. Therefore, Applicants conducted additional tests and loudspeaker diaphragms W1 and W2 were manufactured in the same manner as Examples 1 and 3 of the present specification. However, these loudspeaker diaphragms were manufactured using the plain woven fabric of aramid fiber "KEVLAR", as specifically taught by the Ward patent. Specifically, the plain woven fabric of aramid fiber was used in

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Comparative Example 2 of the present specification in place of the plain woven fabric of PEN fiber (of the present invention). Next, the density, Young's modulus and internal loss were measured in the same manner as Example 1 of the present specification using the woven fabric of aramid fiber taught by the Ward patent. The results are illustrated in Table B.

Table B

	KEVLAR (W1)	KEVLAR impregnated with melamine resin (W2)
Density (g/cm <sup>3</sup> )	1.40	1.42
Young's modulus (dyne/cm <sup>2</sup> )	$8.20 \times 10^{10}$	$8.22 \times 10^{10}$
Internal loss (tan $\delta$ )	0.02	0.019

As clearly evident in Table B, even when the aramid fiber "KEVLAR" is impregnated with melamine resin, the Young's modulus is not improved and the internal loss maintains at a low level. Therefore, as illustrated in the above Tables A and B, the loudspeaker diaphragm of the Ward patent does not provide an excellent balance between a Young's modulus and an internal loss. In summary, the impregnation of the woven fabric of the Ward patent with the thermosetting resin (melamine) of the present invention does not and cannot result in the new and unexpected results provided by forming the loudspeaker diaphragm base layer from a woven fabric of PEN fiber impregnated with a thermosetting resin.

Applicants respectfully assert that there are other factors that should be considered with respect to the presently-invented loudspeaker diaphragm, namely "secondary considerations" that further demonstrate that the claimed invention is not obvious to one skilled in the art. In particular:

Objective evidence or secondary considerations such as unexpected results, commercial success, long-felt need, failure of others, copying by others, licensing, and skepticism of experts are relevant to the issue of obviousness and must be considered in every case in which they are present. When evidence of any of these secondary considerations is submitted, the Examiner must evaluate the evidence.

MPEP § 2141; *see also* MPEP § 716

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Accordingly, Applicants respectfully submit that the above experiments clearly evidence such new and unexpected results, i.e., improved Young's modulus and internal loss, provided by practicing the present invention. Applicants further submit that these new and unexpected benefits are the results of considerable experimentation and analysis. Still further, and again, the '099 publication describes a loudspeaker having a small diameter that uses a PEN film diaphragm, which is not useful in the same application as the present invention. The loudspeaker diaphragm of the present invention uses a PEN woven fabric. In the previous response, Applicants set forth the important differences between a PEN woven fabric diaphragm and a PEN film diaphragm.

Now, the Examiner references the woven fabric of the Ward patent, and combines this fabric with the PEN film of the '099 publication. As demonstrated above, simply using the woven fabric taught by the Ward patent, and impregnating it with thermosetting resin, does not lead to the above-discussed new and unexpected results. Specifically, the Young's modulus is not improved, and the internal loss remains at a low level. Applicants further submit that it is not obvious to simply combine the teachings of the '099 publication (PEN film for a micro speaker) with the teachings of the Ward patent (a woven fabric of aramid fiber). This is especially borne out by the fact that neither the Ward patent nor the '099 publication teaches or suggests the use of a PEN woven fabric.

Again, the Ward patent teaches a loudspeaker diaphragm having a base layer of woven fabric of aramid fiber, and the '099 publication teaches the use of PEN film for use in manufacturing micro speakers. Therefore, Applicants respectfully submit that neither of the references, nor the combination of these references, teach or suggest the use of a PEN woven fabric, as specifically set forth in each of the independent claims of the present application. Still further, none of the '099 publication, the Ward patent, the Kanada publication, the Watanabe publication, the Yamaji patent, EP '596, the Inoue patent nor the Ogura patent teaches or suggest a loudspeaker diaphragm including a base layer having woven fabric of polyethylene naphthalate fiber impregnated with thermosetting resin, as specifically set forth in each of independent claims 1, 14, 15 and 17 of the present application. It is the use of this PEN woven fabric (as opposed to a woven fabric of aramid fiber or a PEN film) that leads to the new and unexpected results set forth above.

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Summary

For the foregoing reasons, independent claim 1 is not anticipated by or rendered obvious over any of the cited prior art, whether used alone or in combination. Again, Applicants respectfully submit that there is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 1 is respectfully requested. Claims 2-13 and 20 depend either directly or indirectly from and add further limitations to independent claim 1 and are believed to be allowable for the reasons discussed hereinabove in connection with independent claim 1.

For the above reasons, independent claim 14 is not anticipated by or rendered obvious over the prior art of record, whether used alone or in combination. There is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 14 is respectfully requested.

For the above reasons, independent claim 15 is not anticipated by or rendered obvious over the cited prior art, whether used alone or in combination. There is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 15 is respectfully requested. Claim 16 depends directly from and adds further limitations to independent claim 15 and is believed to be allowable for the reasons discussed hereinabove in connection with independent claim 15.

Finally, and for the foregoing reasons, independent claim 17 is not anticipated by or rendered obvious over the prior art of record, whether used alone or in combination. There is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 17 is respectfully requested. Claims 18 and 19 depend either directly or indirectly from and add further limitations to independent claim 17 and are believed to be allowable for the reasons discussed hereinabove in connection with independent claim 17.

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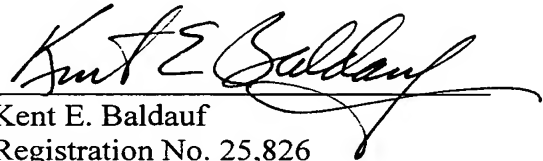
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For all the foregoing reasons, Applicants believe that claims 1-20 are patentable over the cited prior art and in condition for allowance. Reconsideration of the rejections and allowance of all pending claims 1-20 are respectfully requested. Further, the undersigned respectfully requests that the Examiner contact him in order to further discuss the present submission in order to move this case towards allowance.

Respectfully submitted,

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